THE SURGICAL TREATMENT OF TORTICOLLIS, WITH ESPECIAL REFERENCE TO THE SPINAL ACCESSORY NERVE.

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IT is not intended by the writer to epitomize and present the history of the operative procedures in the treatment of torticollis. In this particular branch of surgery the introduction of antisepsis, if it did not actually revolutionize the methods of treatment, did much to establish a feeling of confidence on the part of the surgeon that enabled him to revive older measures, as, for example, the division of the spinal accessory nerve, with the firm conviction that such an operation, involving, as it does, penetration beyond the plane of the deep cervical fascia, would not be followed by the development of blood-poisoning.

Not only, however, was, by the introduction of antisepsis, the great danger of wound infection very largely eliminated, but also, by obtaining primary union, disagreeable and frequently unsightly scarring was avoided. In such a conspicuous part of the body as the face and neck the probability of such unfortunate scarring (provided that the patient escaped the primary danger of infection) led the "pre-antiseptic" surgeon to perform the operation of division of the tendon of the sterno-mastoid through a very small incision, constituting, in fact, a punctured wound, through which, in the first place, it is difficult as well as uncertain to operate satisfactorily; and, in the second place, such a wound as this, as is well known, is more apt to be followed by infection, provided that the agents of infection exist, than is the case with a wound in which the division of the skin and subcutaneous tissue is more extensive, and more in suitable proportion to the exposure of the underlying tissues.

Therefore we shall treat of the different operative procedures which the surgeon can satisfactorily perform, with the knowledge and co-operation of antiseptic principles.

Before we do this, however, a comprehensive description of the anatomical features of torticollis, and, secondly, of the different varieties of this trouble, will facilitate the selection of any special therapeutical measure for any individual case.

By torticollis is usually meant the position of the head that results from an abnormal shortening of the sterno-mastoid muscle. The head enjoys great freedom of movement in virtue of several joints. Of these, the atlo-occipital articulation is admirably adapted to the so-called nodding movements,—namely, flexion and extension, the atlo-axoid to very extensive rotation, while lateral motion (abduction) is accomplished by the movement of the cervical vertebræ on each other. If the right sterno-mastoid contracts, moderate extension, a sweeping of the chin towards the opposite (left) side, and an approximation of the right side of the head to the right shoulder occur, as a result respectively of movement in the joints just mentioned.

But, although the study of the contraction of a sterno-mastoid enables us to appreciate the position of the head in torticollis, yet, on the other hand, it must be remembered that other muscles passing over these joints necessarily contribute, if in a condition of contraction, to the false position of the head. Posteriorly, the muscles of the neck, taking their point of action from their origin at the bony process of the upper dorsal and lower cervical vertebræ, extend the head, if they pass over the atlo-occipital joint to the occiput, in virtue of their vertical fibres, whereas, in addition, those muscles which move obliquely upward and outward to the lateral portion of the occiput approximate the head to the shoulder on the same side, as does the corresponding sterno-mastoid. The deeper muscles, attached to the transverse process of the axis and passing over the atlo-axoid joint, rotate the head upon a vertical axis to a lesser or greater degree, according to the obliquity and number of their component fibres. Then, again, the result of this action resembles the rotary power of the sterno-mastoid, but with this important difference, that, whereas the sterno-mastoid rotates the chin towards the opposite side, the inferior oblique (for this is the rotatory muscle chiefly concerned) rotates the chin towards the same side, in antagonism to the rotatory power of its sterno-mastoid fellow. Thus, were we dealing with a contraction of the right sterno-mastoid, the simultaneous contraction of the left inferior oblique would intensify the resulting rotation, and would render the return of the head to the antero-posterior plane a more difficult matter.

Torticollis due to muscular contraction may therefore be of a very complex nature, and the determination of the exact muscles involved may be extremely difficult.

It is not, however, always the result of muscular contraction or shortening. Exceptionally, the head deviates from its natural position because of actual loss of substance in the supporting vertebral column, the result of inflammation, or the subsequent contraction of cicatricial bands, resulting from the healing of extensive granulating surfaces (as in burns) that, passing from the lower parts of the neck upward to the inferior maxilla, or the skull behind, produce abnormal positions, which may or may not resemble the position of torticollis, but the conideration of which does not at present demand our attention.

Torticollis may be congenital. Such cases occasionally present themselves, and their exact cause has given rise to much discussion. Whether the deficiency in length of one of the sterno-mastoids is due to some abdominal intra-uterine position, or to a hæmatoma, situated in the muscle itself, as a result of undue traumatism during labor, or to some actual deficiency in embryological development, has not been fully determined. Of these different factors, the first two have been so ably discussed by Stromeyer, Petersen, and Lorenz, as to need no further remark. In support of the theory of deficient development, it may be stated that the study of practical anatomy affords numerous illustrations of the lack of muscular symmetry.

To be sure, this is more frequently seen in muscular anomalies, but that this is not always the case is proven by the fact that even such a large and constant muscle as the pectoralis[1] major may be very rudimentary on one side of the body, while the opposite muscle will be perfectly normal.

In the neck muscular variations are frequently encountered, and it is certainly conceivable that the sterno-mastoids[2] may thus be unequally developed.

The actual pathological condition of congenital torticollis, no matter what the precise cause, consists in an inequality in the length of the sterno-mastoid muscles, secondary to which is developed a scoliosis in the cervical vertebræ, with an asymmetry of the soft parts, cartilages, and rarely bones of the corresponding half of the face; secondary, because the restoration of normal length to the affected sterno-mastoid allows the return of the head to its normal position, while both facial atrophy and scoliosis disappear.

But although the actual shortening in these congenital cases is the most conspicuous and sometimes the only change in the muscle, yet in other cases there is also present the element of contraction, either spasmodic or constant, which, as we shall mention later, materially changes the muscle substance or cervical fascia or both. Usually the latter, which is the first to take place, is more marked and leads to the formation of thickened, contracted bands of connective tissue, that should be divided in operations for the relief of this condition.

Secondly, torticollis may be acquired. This is due to some factor that, by its irritation, results in a spasmodic contraction of the sterno-mastoid muscle, followed by a similar contraction of the deeper muscles that move the head on the vertebral column, the contractions being intermittent in character, and, according to the severity of the case, being separated by longer or shorter

[1] Dr. Huntington tells me, that, comparatively recently, one example of complete unilateral absence of pectoralis major, pectoralis minor, and latissimus dorsi, has been observed in the dissecting room of the college.

[2] This is rare in the mesial line of the body, but is especially apt to occur where, in the embryological development of the body, the lateral arches join. In the neck this line of union corresponds to the position of the sterno-mastoid muscle.

intervals of time. Between the attacks the head is held in the characteristic position, and the onset of a paroxysm is marked by an exaggeration of the deformity and by severe pain.

In the majority of cases this contraction seems to be entirely of a reflex nature, independent of the patient's will, uncontrollable, the origin of the impulse being some irritation, such as an inflammatory process in the immediate vicinity of the sterno-mastoid or trapezius muscle, or of the joints moved by them.

This condition is of frequent occurrence in cervical adenitis. Long chains of glands are situated beneath the sterno-mastoid, and when for any reason these become the seat of inflammation, torticollis frequently results. In these cases, when, by therapeutical measures, the adenitis after a short duration subsides, the torticollis generally disappears.

But the cause of this trouble is not always so easily recognized, nor does the subsidence of the torticollis always yield readily to simple therapeutical remedies ; and it is precisely in this class of cases, after local applications to the muscle and internal treatment have failed, that surgical interference is required, with the object of breaking "the circuit," by which "the current" producing these painful contractions travels.

As yet, no localized inflammatory condition, situated in that part of the central nervous system and upper spinal cord from which the spinal accessory and motor filament of the cervical plexus take origin, has been established as a cause of this condition. Neither has spasmodic torticollis been definitely connected with any pathological lesion in the high cortical centres of motion, nor has it been attributed to any abnormal change in the centrifugal nerves that supply the muscles affected. Repeated operations have been reported in which a portion of the spinal accessory nerve as well as the post-cervical nerves have been removed, but in no instance has the writer found a statement of a subsequent microscopical examination of the segment or segments of nerves thus taken away. Such examinations should be made with a view of determining how much, if ever, diseased nerves may be ascribed as a cause of this condition.

Spasmodic torticollis, clinical evidence shows, is a disease in which at first but one muscle, and that usually a sterno-mastoid, is involved. This is followed, however, by the contraction of other deeper muscles in the neck until, in advanced cases, but few exist that do not take part, more or less, in the production of the deformity. Hence spasmodic torticollis may be said to have a distinctly progressive character. This is of importance in considering the pathological changes that occur in the muscles as well as in some of the other tissues of the neck as a result of these intermittent, painful contractions; for, although, in the early stages and in cases of short duration, no such changes can be detected, still, if the progress of the disease continues unchecked, the muscles and their fascial investments will be altered to such a degree as to cause one of the most obstinate forms of torticollis, which it is very difficult to cure. In these most advanced cases the abnormal position of the head is extreme, even during the intermissions in which the patient is free from paroxysms, and even the relaxation caused by an anæsthetic will not ameliorate the deformity. Nor is it the simple shortening of the muscle that occurs in the congenital cases, because in them the shortened muscle is normal in its histological features, while with these advanced cases the muscle, both in its gross appearance and under the microscope, shows very marked changes.

Vollert has shown the presence of connective tissue between the individual muscular fibres, which, in the mildest cases, is absent or slight in amount, but which, in severe forms, may exceed in amount the remaining muscular fibre. Not only in the muscle itself but also in its sheath are changes very marked. This portion of the cervical fascia is thickened to a remarkable extent by an increase in the connective tissue, of which it is normally composed, while subsequent changes of contraction, common to all new connective-tissue formations, result in the formation of tense bands that pass in front and behind the muscle over the vascular sheath, and these bands, while exaggerating still further the deformity, render it possible to accomplish its cure only by their careful and thorough removal.

With this understanding of the subject, we may proceed to the consideration of the different surgical procedures applicable to the various groups of cases that we have described.

The indication to be accomplished in the congenital cases is clearly defined. The shortened sterno-mastoid muscle must be lengthened, until it equals the length of its fellow-muscle. This is most easily accomplished by dividing the tendon of the muscle at its sterno-clavicular attachment. When divided, the head can readily be brought into a normal position and held there by suitable orthopædic appliances, until all danger of subsequent contraction has passed. In what way is this tenotomy to be performed?

The subcutaneous division of the sternal head has been a favorite operation, and is accomplished by making a small opening near the inner prominent part of the tendon, through which is introduced the firm blade of a tenotome, either between the muscle and the skin or between the posterior surface of the muscle and the deep cervical fascia. In both the edge of the knife is turned towards the muscle, which is divided by a succession of sawing movements, until the complete division is shown by a sudden snap of the yet unsevered portion of the tendon.

This operation has many adherents, is still much in vogue, and it certainly yields good results. Some surgeons divide the tendon from before backward, and others divide it in the opposite direction. The latter method is favored by the majority because the danger of important vessel-penetration ceases after the knife, introduced along the easily-felt edge of the tendon, has been turned against the surface of the muscle, while these same vessels, by the other method, are more apt to be wounded when the knife, after dividing the tendon, comes suddenly in contact with the vascular sheath before it can be withdrawn. This, in fact, comprises the only danger, besides possible infection, a danger that is not of a "theoretical" nature, for cases where even the internal jugular vein has been wounded have been reported by candid surgeons, and although not necessarily a fatal accident, still, of course, it exposes the patient to the risks of hæmorrhage and of entrance of air into the vein.

Consequently, the open operation, when the tendon is exposed by a transverse incision and carefully divided under the surgeon's eye, is preferred by many, and is especially desirable in those congenital cases in which a certain amount of spasmodic or constant contraction of the muscle indicates the beginning of thickened cervical fascia. Here the accurate introduction of the tenotome behind the tendon would be difficult, as the line of demarcation between the deep fascia and the posterior surface of the muscle would not be sharply defined and vessel-penetration would be difficult to avoid, whereas, if the muscle were divided from before backward, a tense band of fascia undivided might still prevent the full reduction of the deformity and induce the operator to continue dividing the resistant bands until the head could be brought into a normal position, with considerable risk of damage to an important vessel.

Schwartz, an advocate of the open method, reports a case in which a subcutaneous operation would surely have wounded the internal jugular vein, or, if not, would have left undivided a cicatricial band, which tightly embraced the anterior surface of this vein, and which prevented complete reduction of the deformity. By means of the open operation this band was easily divided without injuring the vein, and a good result was obtained.

It would appear, therefore, that where the division of the sterno-mastoid tendon was indicated, the subcutaneous operation could be safely performed if the muscle were simply shortened; but, on the other hand, that the open operation is indicated where the presence of any spasmodic or constant contraction would render the surgeon likely to encounter cicatricial bands of greater or lesser density, which would require division.

Spasmodic torticollis, advanced and long existing, cannot be treated successfully by simple division of the sterno-mastoid tendon. To be sure, by this means temporary relief would ensue, and in a minority of cases a cure would be effected, for the reason that when the divided tendon had united in such a way as to resume its function, the exciting cause might have disappeared, perhaps entirely, perhaps subsequently to return. Hence operations on the tendon itself for the relief of spasmodic torticollis do not yield entirely satisfactory results. If, however, the path of the impulse producing a painful contraction be interrupted by a surgical procedure on the nerve that supplies it, "the circuit will have been broken" in a more favorable "section," and the relief to the patient will, if temporary, be of longer duration, and not infrequently a permanent cure may be expected.

For this purpose the spinal accessory nerve has been exposed in at least two different ways, and has afterwards been subjected to a variety of procedures.

The nerve may be reached by an incision three inches in length, along the middle portion of the posterior border of the sterno-mastoid muscle. After its posterior edge is exposed search is made for the nerve, as it leaves this muscle near its centre to terminate in the trapezius after crossing the occipital triangle of the neck. The nerve when found is followed carefully through the muscle until that portion of it which lies between its point of exit from the skull and its point of entrance into the muscle is exposed, and in this situation it is subjected to some suitable surgical procedure.

This method of reaching the nerve is certainly utilized by comparatively few surgeons. Its only advantage is its safety. There is no region in the neck in which an incision may be made with less risk, so far as wounding of important structures is concerned, unless, perhaps, the anterior median line of the neck, and here, certainly, the incision cannot be carried to any considerable depth without the exercise of due care and attention.

Its disadvantages, however, are multiple. Even when that portion of the nerve, after it has emerged from the sterno-mastoid muscle, is well developed, it is not an easy matter to distinguish it from descending branches of the cervical plexus to the trapezius, for not only is it as it crosses the neck parallel to these nerves, but also a free anastomosis between the spinal accessory and the second cervical nerve, at the edge of and beneath the muscle, still further renders its detection difficult. Nor is its identity revealed by mechanical or electrical methods of stimulation, for several of these descending branches of the cervical plexus would, if subjected to the tapping of a scalpel, or to the more scientific electric current, result in a contraction of the trapezius, in precisely the same way as the spinal accessory, under similar conditions, would behave.

Another objection consists in the fact that this part of the spinal accessory is not always well developed. The writer recalls instances in the dissecting-room where, after supplying the sterno-mastoid, only a minute filament could be traced into the cervical plexus so small as to surely escape detection in any surgical procedure, while the trapezius was apparently supplied altogether by the cervical plexus. Certainly in these cases, as well as in others more numerous, where the terminal part of the nerve instead of being practically absent was very small, it would be very difficult to find the nerve in this part of its course.

Another variation of interest to which the nerve is subject, and which, if present, would confuse one who was searching for this structure through the posterior incision, is its failure to penetrate the sterno-cleido-mastoid muscle.

In two instances within the present year the nerve of considerable size passed entirely underneath this muscle, giving to it only a small branch, which left the parent trunk just below the posterior belly of the digastric to enter the muscle in the usual place.

The operation in which the nerve is reached by an incision along the anterior border of the muscle is more generally employed. This procedure is, unlike the other, not absolutely free from risk. Neither is the detection of the nerve always easily accomplished, although in the end it is absolutely certain to be found, and usually not after a prolonged search.

For these reasons, through the kindness of Dr. G. S. Huntington, professor of anatomy in the College of Physicians and Surgeons, the writer was enabled to make a series of dissections for the purpose of establishing, if possible, some guide or method of procedure by which the nerve could readily be exposed, and with the least risk to the patient.

The incision should be generous, for the nerve is situated at a considerable depth, and should extend from the mastoid process above downward to one or two inches beyond the angle of the jaw. The anterior edge of the sterno-mastoid should then be exposed. In the upper part of the wound the posterior and inferior portion of the parotid gland may have to be drawn forward, although usually it does not overlap the muscle. When this is done, it is comparatively easy to expose by blunt dissection the transverse process of the atlas, as it lies directly below the mastoid process above, while immediately in front of this bony prominence, and running downward and forward from the mastoid process towards the angle of the jaw, is the posterior belly of the digastric. Behind this lie the main vessels of the neck with the spinal accessory nerve emerging from the jugular foramen, and the operator is certain that no harm can be done to these structures as long as he remains superficial to the digastric belly, which in its turn lies at a considerable depth,—in fact, at about the level of the transverse process of the atlas.

Owen and Petit have drawn attention to the fact that the nerve usually enters the mastoid muscle at a point opposite the angle of the jaw. I have found, however, in a large majority of cases that, on leaving the internal jugular, it assumes a definite relationship with the transverse process of the atlas. Never above it, sometimes directly over it, usually a fraction of an inch in front of its most prominent part, the nerve may easily be detected in the small amount of connective tissue that envelops it, and from this point to its entrance into the belly of the muscle it may be isolated with safety, and treated by any suitable procedure. If, exceptionally, it should escape detection, the anterior border of the muscle should be drawn sharply backward at a point opposite the angle of the jaw, the nerve in this way put on the stretch, and by blunt dissection in the adipose tissue that separates the under surface of the muscle from the sheath of the vessels, the nerve may readily be exposed. Usually the nerve passes from under the posterior belly of the digastric, at a point just in front of the transverse process of the atlas, to a point on the deep surface of the muscle just behind its anterior margin opposite the angle of the inferior maxilla. It is sometimes accompanied by a small artery and vein, the latter easily visible, the former a branch of the occipital. Rarely the nerve lies at a considerable distance from the transverse process of the atlas; in one case as much as half an inch anteriorly. Here the nerve could be found at its entrance into the muscle, the landmark of the transverse process having failed to localize its situation.

The risks of the operation really are few. Some writer calls attention to the fact that the external jugular may give rise to troublesome hæmorrhage after the incision through the skin, but such an incision only affects, in its uppermost part, the radicles of the vein, which, as is well known, quickly crosses the superficial surface of the muscle, in company with the auricularis magnus nerve, and the resulting hæmorrhage can easily be controlled. Damage to the internal jugular is possible, but if, after exposing the posterior belly of the digastric, blunt dissection is alone practised, such an accident cannot occur.

The occipital artery, as it passes upward above the transverse process of atlas to the mastoid process, usually lies in front of the nerve. In the majority of dissections this vessel lies *behind* the belly of the digastric, and hence is not seen. Its branches to the sterno-mastoid are divided, but the hæmorrhage, although troublesome, is easily controlled. Rarely the artery lies at a lower level, and passes below the transverse process, when it might be divided. If the incision is ample, there is no difficulty in securing the divided ends.

The facial is the only important nerve that lies near the field of operation, but this comes no nearer than the superior border of the digastric belly, and, therefore, is not liable to damage.

Mention has previously been made of the fact that inflammatory processes in the vicinity of the muscle may lead to the development of spasmodic torticollis. Such processes very frequently involve the deeper cervical lymphatic glands, and of these the enlargement of those that lie under and in front of the upper portion of the sterno-mastoid may increase the difficulty of the operation. These glands are situated in a capsule of adipose tissue, and dissection in this tissue can be carried on without fear of damage to the underlying vascular sheath, and usually the nerve is readily found running obliquely between the enlarged glands to the muscle.

After the nerve has been isolated in this way, different surgical procedures have been employed, with varying success.

Deaver, in a case of traumatic origin, ligated the nerve with silver wire, which remained encysted in the wound. Primary union followed, but the subsequent result is not mentioned.

By others the nerve has been simply stretched. Smith reports a case of sixteen years' duration, in which the procedure was followed by temporary improvement. But this usually is of short duration, and in this particular case was followed in one week by excision of a portion of the nerve one-third of an inch in length. Absolute paralysis of both sterno-mastoid and trapezius resulted.

Gould reports a case in which, during the process of stretching, the nerve gave way. Subsequent traction resulted in the removal of a delicate strand, representing the spinal portion of the nerve. This method of "nerve-avulsion" was followed by no unfavorable symptoms, and at the end of a year the patient, who prior to the operation had been a sufferer for eight years, showed no tendency to recurrence.

Usually the excision of a portion of the nerve is preferred to any of the above procedures. The segment removed should be from one-third to one inch in length. Complete paralysis of the corresponding sterno-mastoid and trapezius muscles followed this procedure, in the case reported by Smith, and in another similar one, reported by Griffith and Halwell.

There is no doubt, therefore, of the immediate relief which the patient obtains as a result of this operation in a case of spasmodic torticollis in which these muscles are involved, and in a considerable number of such cases this relief is permanent. It must be remembered, however, that frequently the deeper muscles of the neck, supplied, not by the spinal accessory, but by branches of the posterior cervical plexus, are involved, and that, naturally, the contraction of these muscles would not theoretically be affected by division of the spinal accessory nerve. It is an interesting fact to observe, however, that such division has been followed by temporary amelioration in the contraction of the splenius capitis and adjacent muscles of the opposite side, although this improvement lasted only three or four days.

In order to effect a cure in those cases in which torticollis is produced by contraction of the deep posterior muscles, the nerves which are distributed to these muscles must be exposed and divided. This is best accomplished by division and excision of the posterior nerve-roots as they issue from the intervertebral foramina; a procedure that was originated by Keen, and which, since then, has been done by other surgeons. The roots themselves must be divided, because, shortly after its emergence from the spinal canal, each nerve, with the exception of the first or suboccipital, divides into an external and internal branch, the former muscular, the latter principally cutaneous. The division of the roots thus insures the division of the motor portions of these nerves. This procedure has yielded excellent results, although the short time in which it has been practised has not been sufficient to form an accurate estimate of its worth.

In the case previously cited, in which Smith stretched and subsequently excised a portion of the spinal accessory nerve, the spasmodic contractions of the deeper muscle still persisted. Five weeks after the excision of this nerve the posterior divisions of the upper cervical nerves, with the exception of the suboccipital, were divided and a complete cure was accomplished. Two years after this last operation the patient had not had any recurrence of his former trouble.

A similar and equally brilliant result is reported by the same writer, in another case, where two years had elapsed since the operation was performed, and the patient continued well.

It seems, therefore, perfectly justifiable to reach the conclusion that, in cases of spasmodic torticollis, where non-operative procedures of treatment have failed, a portion of the spinal accessory nerve should be excised; in some cases this is sufficient to effect a cure, especially when the painful spasms are due to contraction of the sterno-mastoid and trapezius muscles; that, in other cases, when, in addition, the deeper muscles are involved, the posterior cervical nerve-roots should be excised close to their origin from the spinal canal on the affected side, and that this procedure will certainly, in the majority of cases, be followed by a permanent cure.

As yet no cases have been reported in which the posterior cervical nerves have been divided before the spinal accessory. It has been stated that the prior division of this latter nerve is followed at the time by a temporary improvement in the spasmodic contractions of the deeper muscles. It is among the possibilities, however, that the disease may originate in this latter situation, and it would be very interesting to see what effect primary division of the post-cervical nerves might have upon a coexisting, but subsequently developed, spinal accessory irritation.

We have still to consider the treatment of those cases of torticollis in which, from the long period through which muscular contractions have persisted, a permanent shortening, not only in the sterno-mastoid muscle but also in other deep muscles of the neck and in the deep cervical fascia, takes place. These changes have been previously described and need not again be repeated. In addition, however, the patient is subject to attacks of spasmodic contraction of the affected muscles, resulting in great pain and still greater distortion of the head. This latter condition can be treated by division of those nerves that innervate the affected muscles, but this procedure does not relieve the deformity due to the mere shortening of the muscle or muscles, which becomes more and more aggravated by the continued and uninterrupted contraction of connective-tissue bands, which infiltrate both muscle and deep cervical fascia.

In this class of cases it is necessary to remove the cicatricial bands that prevent the head from assuming its natural position, wherever they exist, and this, naturally, can best be accomplished by an open operation in which the region of the neck in the vicinity of the sterno-mastoid muscle is thoroughly exposed by an ample incision along the anterior border of the muscle, from the lower extremity of which a transverse incision extends for several inches parallel to the upper border of the clavicle. The offending bands of fascia, together with that portion of the sterno-mastoid that has permanently been altered, is carefully dissected and removed. When the operation is completed the position of the head should be brought into the median line, and should be held in place by a suitable orthopædic apparatus.

In the less severe forms of this type of the disease such a radical procedure as that just described will prove successful. Even in the extreme cases, where a perfect result cannot be obtained, a certain degree of improvement, the greater, the more radical the operation, will be certain to ensue.

Volkmann reports several cases in which the procedure was followed by a cure, and in these cases microscopical examination of the muscle removed showed a great amount of connective tissue distributed through its substance.

It is certain that by no other procedure could a cure be accomplished.

In conclusion, the writer wishes to emphasize the importance of subsequent orthopædic treatment. Reference to this has already several times been made, and it only remains to state that when by operative measures the head is brought into the median plane again, it must be kept there by the wearing of a splint that will hold it firmly in place, and will, by giving perfect rest, favor the complete and rapid union of the wound. That such union should be primary is of the greatest importance. Secondary union would be attended by the formation of cicatricial tissue, the subsequent contraction of which would be difficult to govern.

By means of suitable apparatus is not only a tendency to recurrence prevented, after complete union has taken place, but by its assistance the stretching of bands of fascia that have escaped the surgeon's knife is accomplished, and in this way all tendency to subsequent trouble from this source is averted.

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